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Short Paper

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Abstract

Given the significant costs of suicidal behavior for society, suicide prevention is one of the most urgent issues for most countries. By considering suicidal ideation as a strong indicator of suicide, this paper examines how Internet use influences suicidal ideation and its underlying mechanisms in the context of older adults. Synthesizing the interpersonal theory of suicide with prior literature on Internet use, this study explains that Internet use can reduce suicidal ideation through enhanced social belongingness. Our results using data from 6,056 older adults show that Internet use is negatively associated with suicidal ideation in older adults. The present study further highlights the mediating role of social connectedness (i.e., perceived loneliness and social relationship satisfaction) as an underlying mechanism between Internet use and suicidal ideation. Contributions and practical implications for addressing elderly suicidal problems and future works are discussed.

Keywords: Suicidal ideation, elderly people, Internet use, interpersonal theory of suicide

Introduction

Suicide has become a health and social problem, especially among elderly people. In most countries, the suicide rates of the elderly are the highest compared to other age groups (Shah et al. 2016). South Korea has the highest elderly suicide rate (53.3 per 100,000) among the Organization for Economic Co-operation and Development (OECD) countries. Suicide prevention for older adults is one of the most urgent issues in South Korea and other developed countries. Social isolation is a primary reason for suicidal ideation and attempt of older adults (Calati et al. 2019). The recent COVID-19 pandemic has aggravated this societal problem of elderly suicide by decreasing social contacts and lowering access to community services (Zalsman et al. 2020).

With advances in information and communication technologies (ICTs), Internet access has significantly changed how people interact with others. Beyond the economic impacts of ICT, social and psychological consequences of Internet use have drawn the attention of policymakers and researchers including depression, psychological well-being, and loneliness (Cotten et al. 2013; Cotten et al. 2012). Considering significant costs for society and the burden on individuals incurred by suicidal behavior including medical and work loss costs and the well-being of close ones, scholarly interest has grown in studying the impacts of the Internet on suicidal ideation, which is a strong indicator of suicide (Joiner 2005; Van Orden et al. 2010).

Although prior qualitative and quantitative studies have explored the association between Internet use and suicidal behavior such as suicidal ideation and attempts (e.g., Dunlop et al. 2011; Huang et al. 2020), findings are not consistent. For example, some studies noted that Internet use would instigate suicidal behavior as the Internet enables individuals to easily access suicide-related content (Dunlop et al. 2011; Ortiz and Khin Khin 2018). Huang et al. (2020) also demonstrated that problematic Internet use (e.g., addiction and compulsive use) can worsen mental health, thus increasing suicidal ideation. On the other hand, other studies explained that Internet access can decrease suicidal behavior through online support groups in forums (Gilat and Shahar 2009) and online self-help programs (De Jaegere et al. 2019).

As the main limitation in previous studies, prior empirical works have focused on the impacts of Internet use mainly in the context of adolescents and young adults who are proficient in the Internet and the majority of Internet users (Arrivillaga et al. 2020; Huang et al. 2020). Little attention has been paid to the association between Internet use and suicidal ideation in the context of elderly people. Moreover, a few studies have empirically examined the underlying mechanisms between Internet use and suicidal ideation (Jun and Kim 2017).

This study aims to answer the following research questions: *(1) How does Internet use affect suicidal ideation among elderly people* and *(2) what are the underlying mechanisms?* Synthesizing the interpersonal theory of suicide (Joiner 2005; Van Orden et al. 2010) with prior literature on Internet use in the context of elderly people, we theorize how Internet use reshapes the suicidal risks of senior citizens. Specifically, we posit that Internet use alleviates suicidal ideation by enhancing social relationship satisfaction and reducing perceived loneliness.

We provide preliminary empirical evidence using representative samples of 6,056 older adults aged 50 and over from Korea Welfare Panel Study (KOWEPS) data. Our findings show a negative association between Internet use and suicidal ideation among older adults. Regarding the underlying mechanisms, we find that Internet use of elderly people increases social relationship satisfaction and decreases loneliness, alleviating the likelihood of suicidal ideation.

This paper contributes to the literature on ICT use and suicidal behavior by examining the association between Internet use and suicidal ideation in the context of elderly people and empirically demonstrating the underlying mechanism. Our findings in this study can provide practical implications. Policymakers, as well as Internet service providers, can consider ICT training programs for the elderly to enhance social belongingness and alleviate suicidal risks effectively. As a research-in-progress, this study has more room to be developed. In future research, we can conduct additional analysis in the context of young adults, which allows us to provide further insights on the heterogeneous impacts of ICT use by age groups.

Theoretical Background

Interpersonal Theory of Suicide

This study selects the interpersonal theory of suicide (Joiner 2005; Van Orden et al. 2010) and prior literature to explain the association between Internet use and suicidal behavior (i.e., ideation) for older adults. According to the interpersonal theory of suicide (Van Orden et al. 2010), suicidal ideation of individuals is driven by two interpersonal and psychological factors: thwarted belongingness and perceived burdensomeness. Thwarted belongingness (i.e., loss of social connectedness) describes a state where one's need to belong (i.e., being socially connected) is unmet, which includes loneliness, social isolation, and lack of reciprocal care as indicators. Perceived burdensomeness is a psychological state that individuals hate themselves and regard themselves as a burden to others. Individuals with physical illness or self-hatred (i.e., low self-esteem) are likely to have perceived burdensomeness associated with suicidal desire. With suicidal ideation influenced by thwarted belongingness and perceived burdensomeness, individuals may commit lethal suicidal behavior when they have the capability for suicide. The interpersonal theory of suicide asserts that those two factors are not enough for actual suicide but sufficient for suicidal ideation as a strong indicator of suicide.

By integrating interpersonal risk factors, the interpersonal theory of suicide is widely adopted to understand suicidal behavior in diverse contexts including pandemics (Gratz et al. 2020), adolescents (Barzilay et al. 2015), and patients (Wilson et al. 2013). As older adults tend to live in isolation and struggle with disconnected relationships, loneliness and social isolation have been identified as two key reasons for the

suicidal risk of seniors (Chang et al. 2017; Heuser and Howe 2019). By focusing on social connectedness and related burdens of individuals, the interpersonal theory of suicide can provide a relevant theoretical lens to account for how Internet use can reduce suicide risk in the context of older adults.

Internet and Suicidal Ideation

The Internet has significantly influenced how people socialize with others. Although Internet access allows individuals to increase social contacts and interactions via social network platforms, e-mail and instant messaging (Pénard and Poussing 2010), there are two conflicting views on how Internet use affects interpersonal-mental states (i.e., social connectedness). On the one hand, Internet access can reduce social connectedness (McIntyre et al. 2015). That is, Internet use can decrease face-to-face contact and further weaken the sense of belonging to the real world, thereby aggravating social ties and loneliness (Erdoğan 2008). Young adults with high social media use such as Facebook, Twitter and YouTube are likely to feel more social isolation than those with low social media use (Primack et al. 2017). Studies show that the negative links between Internet use and social well-being are prominent among young adults involving adolescents because they are likely to be vulnerable to risks of maladaptive Internet use (e.g., compulsive and addictive use of Internet) and less likely to benefit from Internet use (Appel et al. 2012). Previous studies have consistently shown that problematic Internet use is positively associated with loneliness of young adults (Odacı and Kalkan 2010).

In contrast, some have argued that Internet access can increase social belongingness by providing opportunities to build new social ties and reinforce established ties. Especially in the context of older adults compared to young adults, it is well-established in the literature that Internet use can increase social connectedness (e.g., Chen and Schulz 2016; Cotten et al. 2013; Stockwell et al. 2021). Based on in-depth interviews with six older people, Ballantyne et al. (2010) found that social network sites can reduce loneliness and increase social satisfaction by allowing older adults to meet new people and keep in contact with existing relationships like old friends and family. With Internet use, older adults are likely to alleviate loneliness by maintaining meaningful social connections that would not have been achieved by face-to-face contact due to possible challenges such as new health challenges and reduced mobility of older adults (Yu et al. 2021). A recent study also shows that Internet use of older adults in European countries is associated with a decrease in social isolation by allowing them to gain social support and engage more in activities in which they are interested (Silva et al. 2022).

Based on the lens of interpersonal theory of suicide, we argue that Internet use of older adults can reduce thwarted belongingness, thus decreasing the likelihood of their desire to suicide. Similarly, prior literature reveals that Internet use can increase social support, which lessens depression and enhances the psychological well-being of older adults (Cotten et al. 2012; Heo et al. 2015). In this regard, we posit that Internet use is negatively associated with suicidal ideation older adults. Furthermore, given findings from prior literature that the Internet is associated with an increase in social connectedness of older adults, we expect that Internet use increases social relationship satisfaction and decreases perceived loneliness, which contributes to lowering the likelihood of suicidal ideation.

Method

Data and Measures

The present study uses data from KOWEPS surveyed by Korea Institute for Health and Social Affairs. The KOWEPS collects data regarding Koreans' living conditions and welfare and is a nationally representative and longitudinal survey through computer-assisted personal interviews for Koreans aged 15 and older since 2006. We use data from the 8 years of the KOWEPS survey from 2012 (Wave 7) to 2019 (Wave 14) since the survey has asked about suicidal ideation as of Wave 7. The sample of the baseline period (Wave 7) comprises 14,604 respondents from 7 states in South Korea. Among them, we identified 6,220 adults who were 50 or older in 2012. The respondents who participated in the survey at least two waves are selected for analysis. The final sample for the present study consists of 42,292 individual-year observations out of 6,056 respondents from 2012 to 2019.

Our dependent variable is *suicidal ideation*, which was measured by a survey item established by KOWEPS, which asks whether each respondent seriously considered committing suicide during the past year. The

question has been widely used to assess suicidal ideation (Meltzer et al. 2011). The dependent variable, *suicidal ideation*, is a dichotomous variable that indicates 1 if respondents have thought about suicide during the past year and 0 otherwise. The main independent variable is *Internet*, measured by asking about respondents' use of the Internet during the past year. This measure accurately reflects the actual use of the Internet, compared to the access to broadband Internet (Ma et al. 2020). For mediation analysis, we employ two mediating variables from KOWEPS data including *social relationship satisfaction* and *loneliness*. These two mediators reflect two components in thwarted belongingness, social isolation and loneliness (Van Orden et al. 2010). *Social relationship satisfaction* is measured by asking the extent to which respondents are satisfied with their relationship with others. This item is rated on a 5-point Likert scale ranging from 1 (very unsatisfied) to 5 (very satisfied). *Loneliness* is measured using one item from KOWEPS data: "I feel lonely as if being alone in the world." This variable has a 4-point Likert scale ranging from 1 (never) to 4 (always).

We also use diverse control variables from KOWEPS data possibly correlated with *Internet* and *suicidal ideation* to mitigate any potential omitted variable bias. We include factors related to components of perceived burdensomeness including *self-esteem*, *chronic disease*, *health status* and *unemployment* (Van Orden et al. 2010). Specifically, *self-esteem* is measured using 10 items with a 4-point Likert scale based on the Rosenberg Self-esteem scale (Rosenberg 2015). *Self-esteem* is operationalized by averaging these ten items. The Cronbach's alpha coefficients of each wave are computed at values between 0.8035 (Wave 10) and 0.8273 (Wave 14), which confirm reliability. *Chronic disease* refers to whether each respondent has taken medication for chronic diseases more than six months. *Health status* indicates the extent to which each respondent is in ill health based on a 5-point Likert scale (1: *very healthy* − 5: *very unhealthy*). *Unemployment* refers to each respondent's employment status (0: employed and 1: unemployed). In addition, we use individual characteristics as control variables including age and ordinary income.

Table 1 reports the descriptive statistics of variables, which show that 3.7% of respondents among the pooled sample have considered suicidal ideation during the 8 years. When it comes to Internet use, 22.2% of the sample has used the Internet.

Variable	Observations	Mean	Std. Deviation	Min	Max
Suicidal Ideation	42,292	.037	.19	0	1
Internet	42,292	.222	.415	0	1
Social relationship satisfaction	42,292	3.669	.661	1	5
Loneliness	42,292	1.397	.663	1	4
Self-esteem	42,292	2.158	.277	1	3.7
Unemployment	42,292	.522	.5	0	1
Health status	42,292	2.982	.928	1	5
Chronic disease	42,292	0.76	.427	0	1
Log(Income)	42,292	7.696	.943	0	13.02
Age	42,292	68.676	10.075	50	94

Note. Income represents ordinary income and is in Korean Won.

Table 1. Summary Statistics of Variables

Analysis

To assess the association between *Internet* (i.e., Internet use) and *suicidal ideation*, we use a linear probability model (LPM) with two-way fixed effects (FE). Linear probability model estimators not only allow interpretable results but also yield consistent estimates (Chatla and Shmueli 2017). Our baseline model is specified as follows:

$$DV_{it} = \beta_0 + \beta_1 Internet_{it} + \text{Control}_{it}\gamma + \mu_i + \delta_t + \varepsilon_{it},$$

where *i* and *t* denote an individual respondent and the year (or wave). DV_{it} indicates suicidal ideation by respondent *i* in time *t*. The main independent variable, $Internet_{it}$, is a binary variable that equals to 1 if respondent *i* used Internet in time *t* and 0 otherwise. $Control_{it}$ is a vector of control variables that includes self-esteem, unemployment, health status, chronic disease, ordinary income, and age. μ_i and δ_t indicate time-invariant individual household fixed effects and year fixed effects, respectively.

We further employ two-stage residual inclusion (2SRI) approach to address possible endogeneity issues (e.g., omitted variable bias) (Terza et al. 2008). That is, our results of the baseline model could be biased due to omitted variables correlated with both *Internet* and *suicidal ideation*. The 2SRI estimator uses a residual from the first stage model as an additional control variable in the second (baseline) model. Specifically, in the first stage, we use a probit model with random effects (RE) to estimate the likelihood of Internet use of respondents. We then add the *Residual* of the first-stage model estimation into the baseline model. To this end, we use an instrumental variable[1] for the first stage estimation. The instrument is a state-level Internet service adoption rate obtained from the Ministry of Science and ICT in South Korea. The instrumental variable is deemed valid in that the adoption rate of Internet service is related to Internet use of individuals living in the area while Internet adoption rate in one geographic region is not necessarily correlated with suicidal ideation of residents. Its correlation with suicidal ideation is also very low.

Furthermore, we employ a three-step mediation analysis to examine how the association between *Internet* and *suicidal ideation* is mediated by *social relationship satisfaction* and *loneliness*. First, we investigate whether Internet use is significantly associated with two mediators such as *social relationship satisfaction* and *loneliness*. Second, we check whether two mediators are significantly related to *suicidal ideation*. In the third step, we examine whether the magnitude of the estimated effect of *Internet* decreases with the inclusion of two mediators in the baseline model.

Preliminary Results

Table 2 summarizes the estimation results for the baseline model. We find that in column 1, the coefficient of *Internet* is negative and statistically significant and that in column 2, the coefficient is consistently significant after including two-way fixed effects. Our 2SRI results for the baseline model in column 3 show that the impact of Internet use is consistently negative and significant even after controlling for the residual obtained from the first-stage model in column 4. Thus, these results consistently support our theoretical argument that Internet use is negatively associated with suicidal ideation.

	(1)	(2)	(3)	(4)
	LPM with FE	LPM with FE	2SRI with FE	Probit with RE
DV:	*Suicidal Ideation*	*Suicidal Ideation*	*Suicidal Ideation*	*Internet*
Internet	-0.012***	-0.0086***	-0.0076***	
	(0.0024)	(0.0029)	(0.0029)	
Residual			-0.0191***	
			(0.004)	
State-level Internet service adoption rate				0.0305***
				(0.0016)
Controls	Yes	Yes	Yes	Yes
Individual & Time FE	No	Yes	Yes	-
Observations	42,292	42,292	42,292	42,292
R-squared	0.015	0.225	0.226	-
Note. Probit model with RE in Column 4 is the result of the first stage model of 2SRI. Robust standard errors in parentheses.				

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[1] The instrumental variable satisfies two conditions as follows: (1) the instrument is significantly correlated with the independent variable of interest (relevance), and (2) the instrument is not directly correlated with the dependent variable (exclusion restriction).

Table 2. Results of the Effects of Internet Use on Suicidal Ideation

Table 3 provides estimation results for the mediation analysis. Specifically, in columns 1 and 2 of Table 3, we use linear regression models to examine the impact of *Internet* on two mediators, *social relationship satisfaction* and *loneliness*. We find that *Internet* has a significant and positive effect on *social relationship satisfaction* while it has a significant and negative effect on *loneliness*. We then confirm that the impacts of two mediators on *suicidal ideation* are statistically significant. In column 3, we find that *social relationship satisfaction* is negatively associated with *suicidal ideation* and *loneliness* is positively associated with *suicidal ideation*. Lastly, we estimate the magnitude of the effect of *Internet* by adding two mediators into the baseline model. We find that in column 4, the estimated effect of *Internet* is still statistically significant but decreases compared to that in the baseline model (column 2 in Table 2). The overall results of the mediation analysis are presented in Appendix A. The mediation test results suggest that older adults with Internet use are less likely to have suicidal ideation via enhanced social belongingness: increased satisfaction with social relationship and decreased loneliness.

DV:	(1) Social relationship satisfaction	(2) Loneliness	(3) Suicidal Ideation	(4) Suicidal Ideation
Internet	0.0617***	-0.0283***		-0.0066**
	(0.0100)	(0.0094)		(0.0029)
Social relationship satisfaction			-0.0089***	-0.0088***
			(0.0020)	(0.0020)
Loneliness			0.0515***	0.0514***
			(0.0025)	(0.0025)
Controls	Yes	Yes	Yes	Yes
Individual & Time FE	Yes	Yes	Yes	Yes
Observations	42,292	42,292	42,292	42,292
R-squared	0.348	0.365	0.247	0.248

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

Table 3. Results for the Mediation Analysis

Discussion and Future Work

With the advances and increasing availability of ICT, both bright and dark sides of ICT use have attracted attention due to its benefits and costs for society (Kim et al. 2011; Oh et al. 2018). However, the focus has been mostly on young adults or adolescents with high proficiency in the Internet and the majority of Internet users. This study extends this strand of research by providing significant findings for the impacts of Internet use in the context of older adults. Based on interpersonal theory of suicide, this study further demonstrates the underlying mechanism that Internet use of older adults decreases suicidal ideation via enhanced social belongingness such as social relationship satisfaction and decreased loneliness.

Our study provides several implications. First, the present study contributes to the literature on ICT use and suicide by examining the impact of Internet use on suicidal ideation in older adults. Although previous works have attempted to explore the association between Internet use and suicidal behavior (Dunlop et al. 2011; Gilat and Shahar 2009), these studies provide mixed evidence. In addition, they focused on the

impacts of Internet use on young people. However, there is little research on the association between Internet use and suicidal ideation in the context of older adults. Thus, using a nationally representative and longitudinal data set in South Korea, this study provides valuable insights for Internet use and suicidal ideation among older adults.

Second, our study contributes to the literature by providing a novel theoretical framework. Based on the interpersonal theory of suicide and prior literature, we explicate the underlying mechanisms between Internet use and suicidal ideation among older adults via social belongingness. Recent works have explored the association between Internet access and suicidal behavior (e.g., suicidal ideation and attempts) but little has attempted to test its underlying mechanisms (Arrivillaga et al. 2020). Contrary to them, this study provides further insights by empirically demonstrating the underlying mechanisms using serial mediation analyses.

Third, our study has practical implications by informing the impacts of Internet use on suicidal ideation of older adults. As social distancing policies during the COVID-19 pandemic prevented individuals from having social gatherings and face-to-face interactions, social isolation has become more prevalent (Reger et al. 2020). Given that social isolation is a significant factor for suicide and suicidal ideation (Calati et al. 2019), building online social ties has become more critical. Our findings suggest that Internet use is a major key for social connectedness amid the pandemic by helping older adults remain socially connected and enhance satisfaction with their social relationships. We urge policymakers and Internet service providers to pay more attention to education programs regarding the elderly's ICT use by understanding the underlying mechanism. That is, policymakers and Internet service providers could consider facilitating Internet use for elderly people by targeting their social relationship satisfaction and loneliness.

This study has several limitations. The first limitation pertains to using secondary data from existing data sources. Because we rely on measurement of Internet use by KOWEPS data, Internet use-related factors with more specific measures are unavailable including frequency and channel. Future research may consider the amount and diverse channels of Internet usage such as personal computers, smartphones, and tablets to examine their heterogeneous impacts on suicidal ideation. The second shortcoming is related to the generalizability of the outcomes of this study. This study uses the sample from South Korea, one of the countries with the most advanced ICT infrastructure. Our findings might not be applicable to samples from other countries. Thus, we suggest future works using samples from countries with low ICT infrastructure or diverse cultures and replicating this analysis to compare findings.

As a research-in-progress, this study can be extended as follows. We may elaborate on the heterogeneous impacts of Internet use on suicidal ideation by age groups. Specifically, in future work, we can replicate our analysis for the sample of adolescents and young adults and compare the effectiveness of Internet use with the main results. Given that previous literature reveals different patterns of Internet usage and the opposite impacts of the Internet on psychological well-being between young and older adults (Chen and Persson 2002), it is expected that the impacts of Internet use would be different by age group. In this regard, we could offer further insights by understanding the heterogeneous impacts of Internet use between older and young adults.

References

Appel, M., Holtz, P., Stiglbauer, B., and Batinic, B. 2012. "Parents as a Resource: Communication Quality Affects the Relationship between Adolescents' Internet Use and Loneliness," *Journal of Adolescence* (35:6), pp. 1641-1648.

Arrivillaga, C., Rey, L., and Extremera, N. 2020. "Adolescents' Problematic Internet and Smartphone Use Is Related to Suicide Ideation: Does Emotional Intelligence Make a Difference?," *Computers in Human Behavior* (110), p. 106375.

Ballantyne, A., Trenwith, L., Zubrinich, S., and Corlis, M. 2010. "'': What Older People Say About Participating in a Social Networking Website," *Quality in Ageing and Older Adults* (11:3), pp. 25-35.

Barzilay, S., Feldman, D., Snir, A., Apter, A., Carli, V., Hoven, C. W., Wasserman, C., Sarchiapone, M., and Wasserman, D. 2015. "The Interpersonal Theory of Suicide and Adolescent Suicidal Behavior," *Journal of Affective Disorders* (183), pp. 68-74.

Calati, R., Ferrari, C., Brittner, M., Oasi, O., Olié, E., Carvalho, A. F., and Courtet, P. 2019. "Suicidal Thoughts and Behaviors and Social Isolation: A Narrative Review of the Literature," *Journal of Affective Disorders* (245), pp. 653-667.

Chang, Q., Chan, C. H., and Yip, P. S. F. 2017. "A Meta-Analytic Review on Social Relationships and Suicidal Ideation among Older Adults," *Social Science & Medicine* (191), pp. 65-76.

Chatla, S. B., and Shmueli, G. 2017. "An Extensive Examination of Regression Models with a Binary Outcome Variable," *Journal of the Association for Information Systems* (18:4), pp. 340-371.

Chen, Y., and Persson, A. 2002. "Internet Use among Young and Older Adults: Relation to Psychological Well-Being," *Educational Gerontology* (28:9), pp. 731-744.

Chen, Y. R., and Schulz, P. J. 2016. "The Effect of Information Communication Technology Interventions on Reducing Social Isolation in the Elderly: A Systematic Review," *J Med Internet Res* (18:1), p. e18.

Cotten, S. R., Anderson, W. A., and McCullough, B. M. 2013. "Impact of Internet Use on Loneliness and Contact with Others among Older Adults: Cross-Sectional Analysis," *J Med Internet Res* (15:2), p. e39.

Cotten, S. R., Ford, G., Ford, S., and Hale, T. M. 2012. "Internet Use and Depression among Older Adults," *Computers in Human Behavior* (28:2), pp. 496-499.

De Jaegere, E., van Landschoot, R., van Heeringen, K., van Spijker, B. A. J., Kerkhof, A. J. F. M., Mokkenstorm, J. K., and Portzky, G. 2019. "The Online Treatment of Suicidal Ideation: A Randomised Controlled Trial of an Unguided Web-Based Intervention," *Behaviour Research and Therapy* (119), p. 103406.

Dunlop, S. M., More, E., and Romer, D. 2011. "Where Do Youth Learn About Suicides on the Internet, and What Influence Does This Have on Suicidal Ideation?," *Journal of Child Psychology and Psychiatry* (52:10), pp. 1073-1080.

Erdoğan, Y. 2008. "Exploring the Relationships among Internet Usage, Internet Attitudes and Loneliness of Turkish Adolescents," *Cyberpsychology* (2:2), pp. 1-8.

Gilat, I., and Shahar, G. 2009. "Suicide Prevention by Online Support Groups: An Action Theory-Based Model of Emotional First Aid," *Archives of Suicide Research* (13:1), pp. 52-63.

Gratz, K. L., Tull, M. T., Richmond, J. R., Edmonds, K. A., Scamaldo, K. M., and Rose, J. P. 2020. "Thwarted Belongingness and Perceived Burdensomeness Explain the Associations of Covid-19 Social and Economic Consequences to Suicide Risk," *Suicide and Life-Threatening Behavior* (50:6), pp. 1140-1148.

Heo, J., Chun, S., Lee, S., Lee, K. H., and Kim, J. 2015. "Internet Use and Well-Being in Older Adults," *Cyberpsychology, Behavior, and Social Networking* (18:5), pp. 268-272.

Heuser, C., and Howe, J. 2019. "The Relation between Social Isolation and Increasing Suicide Rates in the Elderly," *Quality in Ageing and Older Adults* (20:1), pp. 2-9.

Huang, Y., Xu, L., Mei, Y., Wei, Z., Wen, H., and Liu, D. 2020. "Problematic Internet Use and the Risk of Suicide Ideation in Chinese Adolescents: A Cross-Sectional Analysis," *Psychiatry Research* (290), p. 112963.

Joiner, T. 2005. "Why People Die by Suicide," in: *Why people die by suicide*. Harvard University Press, pp. 276-276.

Jun, H. J., and Kim, M.-Y. 2017. "What Accounts for the Relationship between Internet Use and Suicidal Ideation of Korean Older Adults? A Mediation Analysis," *The Journals of Gerontology: Series B* (72:5), pp. 846-855.

Kim, W., Jeong, O.-R., Kim, C., and So, J. 2011. "The Dark Side of the Internet: Attacks, Costs and Responses," *Information Systems* (36:3), pp. 675-705.

Ma, W., Nie, P., Zhang, P., and Renwick, A. 2020. "Impact of Internet Use on Economic Well-Being of Rural Households: Evidence from China," *Review of Development Economics* (24:2), pp. 503-523.

McIntyre, E., Wiener, K. K. K., and Saliba, A. J. 2015. "Compulsive Internet Use and Relations between Social Connectedness, and Introversion," *Computers in Human Behavior* (48), pp. 569-574.

Meltzer, H., Bebbington, P., Brugha, T., Jenkins, R., McManus, S., and Dennis, M. S. 2011. "Personal Debt and Suicidal Ideation," *Psychological Medicine* (41:4), pp. 771-778.

Odacı, H., and Kalkan, M. 2010. "Problematic Internet Use, Loneliness and Dating Anxiety among Young Adult University Students," *Computers & Education* (55:3), pp. 1091-1097.

Oh, W., Acquisti, A., and Sia, C. L. 2018. "Ict Challenges and Opportunities in Building a "Bright Society"," *Journal of the Association for Information Systems* (19:2), pp. 58-62.

Ortiz, P., and Khin Khin, E. 2018. "Traditional and New Media's Influence on Suicidal Behavior and Contagion," *Behavioral Sciences & the Law* (36:2), pp. 245-256.

Pénard, T., and Poussing, N. 2010. "Internet Use and Social Capital: The Strength of Virtual Ties," *Journal of Economic Issues* (44:3), pp. 569-595.

Primack, B. A., Shensa, A., Sidani, J. E., Whaite, E. O., Lin, L. y., Rosen, D., Colditz, J. B., Radovic, A., and Miller, E. 2017. "Social Media Use and Perceived Social Isolation among Young Adults in the U.S," *American Journal of Preventive Medicine* (53:1), pp. 1-8.

Reger, M. A., Stanley, I. H., and Joiner, T. E. 2020. "Suicide Mortality and Coronavirus Disease 2019—a Perfect Storm?," *JAMA Psychiatry* (77:11), pp. 1093-1094.

Rosenberg, M. 2015. *Society and the Adolescent Self-Image*. Princeton University Press.

Shah, A., Bhat, R., Zarate-Escudero, S., DeLeo, D., and Erlangsen, A. 2016. "Suicide Rates in Five-Year Age-Bands after the Age of 60 Years: The International Landscape," *Aging Ment Health* (20:2), pp. 131-138.

Silva, P., Delerue Matos, A., and Martinez-Pecino, R. 2022. "The Contribution of the Internet to Reducing Social Isolation in Individuals Aged 50 Years and Older: Quantitative Study of Data from the Survey of Health, Ageing and Retirement in Europe," *J Med Internet Res* (24:1), p. e20466.

Stockwell, S., Stubbs, B., Jackson, S. E., Fisher, A., Yang, L., and Smith, L. 2021. "Internet Use, Social Isolation and Loneliness in Older Adults," *Ageing and Society* (41:12), pp. 2723-2746.

Terza, J. V., Basu, A., and Rathouz, P. J. 2008. "Two-Stage Residual Inclusion Estimation: Addressing Endogeneity in Health Econometric Modeling," *Journal of Health Economics* (27:3), pp. 531-543.

Van Orden, K. A., Witte, T. K., Cukrowicz, K. C., Braithwaite, S. R., Selby, E. A., and Joiner, T. E. 2010. "The Interpersonal Theory of Suicide," *Psychological review* (117:2), pp. 575-600.

Wilson, K. G., Kowal, J., Henderson, P. R., McWilliams, L. A., and Péloquin, K. 2013. "Chronic Pain and the Interpersonal Theory of Suicide," *Rehabilitation Psychology* (58:1), pp. 111-115.

Yu, K., Wu, S., and Chi, I. 2021. "Internet Use and Loneliness of Older Adults over Time: The Mediating Effect of Social Contact," *The Journals of Gerontology: Series B* (76:3), pp. 541-550.

Zalsman, G., Stanley, B., Szanto, K., Clarke, D. E., Carli, V., and Mehlum, L. 2020. "Suicide in the Time of Covid-19: Review and Recommendations," *Archives of Suicide Research* (24:4), pp. 477-482.
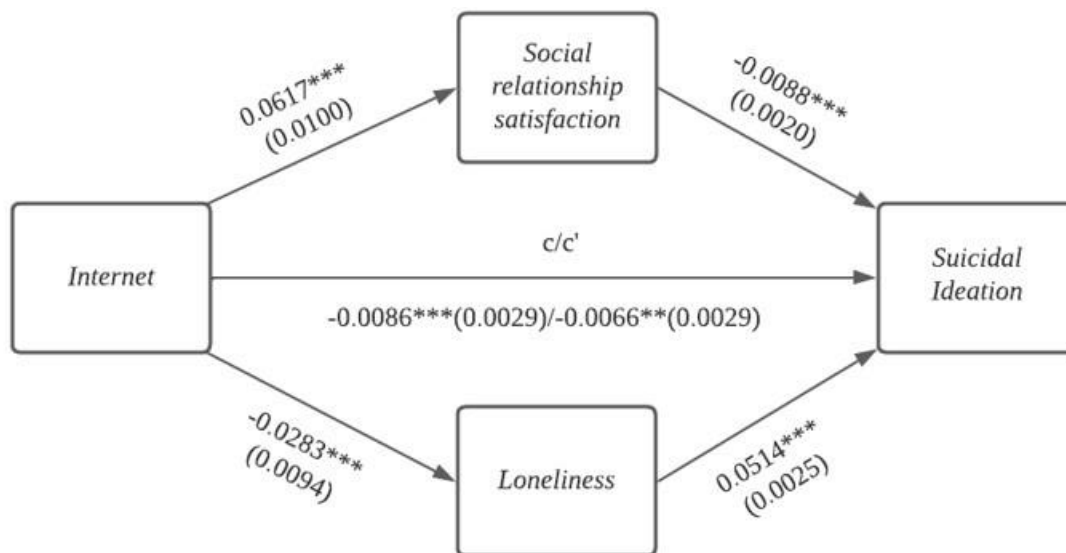
Appendix A. Mediation analysis

Figure 1. Results of Mediation Analysis

Notes. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.